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Texas Mexican American Adult Normative Studies: Normative data for commonly used clinical neuropsychological measures for English- and Spanish-speakers

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Abstract

This study aimed to provide normative references for Mexican Americans on neuropsychological measures of cognitive functioning. Data were analyzed from a total of 797 Mexican-Americans recruited across three Texas-based studies with approximately one-half of the participants tested in Spanish. Normative tables include: MMSE, AMNART, WMS-III (Logical Memory I, II; Visual Reproduction I, II; Digit Span), CERAD, RAVLT, Exit25, CLOX 1 & 2, Trail Making Test- A&B, BNT, COWA and Animal Naming. The norms were stratified by education then age. Normative references were generated for Texas-based Mexican Americans and data may be limited to the population sampled.

Keywords

Hispanic; Mexican American; intellectual capacity; language; executive functioning; memory

Introduction

The population of Hispanic elders is expected to grow seven-fold by 2050 (U.S. Census Bureau, 2004) with rates of mild cognitive impairment (MCI), Alzheimer's disease (AD) and other forms of cognitive impairment expected to increase exponentially (Novak & Riggs, 2004). Since 65% of Hispanics in the U.S. identify as Mexican American (U.S. Census Bureau, 2004), that makes this sample the fastest growing segment of the aging population. AD is currently the 8th leading cause of death among Hispanics (CDC, 2015). Despite a primary goal of the National Alzheimer's Project Act to "improve outcomes for ethnic and racial minority populations," little research on cognitive aging has been conducted among Mexican Americans (O'Bryant et al., 2013a; O'Bryant et al., 2013b).

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Texas, with the second largest Hispanic population in the U.S. is particularly suited to recruit this distinct population. Of the over 10 million Hispanics in Texas, 87% were identified as being Mexican in origin (Available at <http://www.pewhispanic.org/states/state/tx/>). Due to the growing number of Hispanics, particularly in locations such as Texas, normative data specific to this population will become increasingly essential in years to come. A hurdle to this work relates to the term Hispanic itself as it has been referenced as an ambiguous concept with its foundation based on the U.S. Census Bureau's use of the term as an identifier of ethnicity referencing emigrants from Mexico and South America. Other sources have defined Hispanic as individuals of Spanish, Portugal or of Latin American decent (Ponton & Ardila, 1999). However, modernized conceptualizations have been provided, including an updated 2017 U.S. Census Bureau definition of Hispanic origin ([census.gov/topics/population/Hispanic-origin](https://www.census.gov/topics/population/hispanic-origin)). Although a distinct and agreed upon definition of Hispanic has continued to evolve, those who self-identify as Hispanic ethnicity largely originate from Mexico (Data available at <http://www.pewhispanic.org/states/state/tx/>), which is predominately the case for border states such as Texas. Within this context, the term Hispanic will be utilized to reference those individuals who self-identify as emigrating from Mexico and who considered him/herself to be Mexican American.

In order to have a better understanding of this growing population, recent efforts have been made to study factors related to cognitive aging among Mexican Americans (Edwards, Hall, Williams, Johnson, & O'Bryant, 2015; Johnson et al., 2015; O'Bryant et al., 2013a; O'Bryant et al., 2013b). This body of research has shown that Mexican Americans develop cognitive dysfunction at younger ages, are diagnosed at later stages in the disease process, are less frequently impacted by previously established risk factors for cognitive loss (i.e. APOE4), and have lower rates of the APOE4 genotype, which is the single strongest genetic risk for late-onset AD (O'Bryant et al., 2013a; O'Bryant et al., 2013b). Additionally, Mexican Americans have been identified as experiencing an increased risk associated with modifiable factors such as depression (O'Bryant et al., 2013a). More recent work has revealed that Mexican Americans experience greater rates of comorbid depression and diabetes. This specific comorbidity has been shown within this population to be strongly related to risk for cognitive loss (Johnson et al., 2015).

A growing body of literature related to cultural neuropsychology has sought to address ethical concerns related to the use of normative data for ethnically and linguistically diverse individuals. This work has emphasized how currently accepted normative references, which are established predominately among Caucasians who are well-educated do not adequately transfer towards other samples thus raising ethical concerns for use of current normative data in diverse populations (Ardila, Rodriguez-Menendez, & Rosselli, 2002; Manly, 2008). Secondary to this concern, there has been a growing recognition of the importance of cultural issues leading to ethnic-specific normative references for a range of commonly utilized neuropsychological test instruments (e.g. Repeatable Battery for the Assessment of Neuropsychological Status [RBANS, Patton et al., 2003], Wechsler Memory Scale [WMS, Lucas et al., 2005], Rey Auditory Verbal Learning Test [RAVLT, Lucas et al., 2005], Brief Visuospatial Memory Test-revised and Hopkins Verbal Learning Test-revised [BVMT, HVLT, Cherner, et al., 2007], Mini Mental Status Examine [MMSE, Folstein, Folstein, & McHugh, 2001]). Given the size of the U.S. Mexican American population, clinical

neuropsychological practitioners would greatly benefit from the provision of normative references on commonly utilized tests for this rapidly growing population. Such efforts to meet this growing need has resulted in initial psychometric analysis and normative references for the Clock Drawing Test (Menon, Hall, Hobson, Johnson, & O'Bryant, 2012), a Spanish-English equivalent version of the Boston Naming Test (Jahn et al., 2013) as well as an IRT-analysis of the Executive Interview (EXIT) which lead to the development of the EXIT8 (Jahn, Dressel, Gavett, & O'Bryant, 2015) based on data obtained from Mexican American and non-Hispanic white participants. Additionally, the SENAS was created specifically for administration of a Spanish-English equivalent neuropsychological instrument for Hispanics (Mungas, Reed, Crane, Haan, & González, 2004).

While previous efforts have been clinically meaningful, there remains a continued need for available normative references on commonly utilized instruments for English- and Spanish-speaking Mexican Americans. The Texas Mexican American Adult Normative Study (TMAANS) was undertaken to fill this clinical gap through leveraging data from multiple Texas-based research studies: Project FRONTIER (Facing Rural Obstacles Now Through Intervention, Education and Research), Texas Alzheimer's Research and Care Consortium (TARCC), and the Health & Aging Brain among Latino Elders (HABLE) study.

Methods

Participants

TMAANS data includes neuropsychological test results from a total of 797 Mexican Americans across rural and community settings from the following cohorts: TARCC, HABLE, and Project FRONTIER. Participants were provided the opportunity to select their preferred language of test administration (English-based or Spanish-based). The language selected was considered to be the primary language of the participant thereby decreasing biases in test administration due to language barriers that could result from evaluation of a secondary language. Approximately half of the individuals in the sample selected to test in Spanish ($n = 412$).

For the normative references of memory measures, data were analyzed on 653 participants from HABLE and TARCC as Project FRONTIER did not contain these specific measures. The executive measures normative data were derived from total population sampled across HABLE, TARCC, and Project FRONTIER as was the data for measures of attention and intellectual capacity. Due to the compilation of data across studies, some samples sizes for specific tests were small and therefore these reference ranges should be utilized with caution.

Predominantly bilingual psychometricians as well as certified community liaisons with extensive training on neuropsychological assessments were utilized to administer the selected tests in either English or Spanish, depending on the participant's selected language preference. Monolingual psychometricians who spoke only English were also utilized and conducted assessments with participants who were also only English speakers or whose preference was English test administration. All training and test administration was conducted under the supervision of a licensed Clinical Neuropsychologist.

Participants included across cohorts were ages 40 and above per inclusion criteria for the selected studies. This population has been previously shown to present with mild cognitive impairment at younger ages as compared to their non-Hispanic white counterparts. The inclusion of participants in the middle age range was a necessary adjustment to capture early normative references for this at-risk population. The participants selected for this normative study were derived from three distinct studies (Project FRONTIER, TARCC, and HABLE) which sampled both urban and rural areas across Texas and were a representative sample of Texas dwelling Hispanic Mexican Americans. Of note, the community-based participatory research (CBPR) approach utilized in these studies has previously been shown to generate samples that are reflective of the larger population of interest (O'Fallon & Deary 2001; O'Bryant et al., 2011).

The cohorts are briefly described below:

TARCC—The methodology of the TARCC protocol has been described elsewhere (O'Bryant et al., 2010). Briefly, each participant completed an annual assessment at one of the five participating sites that included a medical evaluation, neuropsychological testing, a clinical interview, and a blood draw. All Mexican American participants were recruited via community-based methods at the TARCC sites that focused on Mexican American recruitment. Diagnosis of AD dementia was based on NINCDS-ADRDA criteria (McKhann et al., 1984); controls performed within normal limits on psychometric testing. MCI was assigned according to the Petersen criteria (Petersen, 2003). Institutional Review Board (IRB) approval was obtained at each site and written informed consent was obtained for all participants. The TARCC neuropsychological battery includes the American National Reading Test (AMNART) or Word Accentuation Test (WAT), Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975), Cognitive Dementia Rating (CDR), CLOX, Trail Making Test Part A and B (TMTA and TMTB), Boston Naming Test (BNT), Controlled Oral Word Association Test (COWA), Animal naming, Wechsler Memory Scale -Third Edition (WMS-III, Logical Memory [I, II], Visual Reproduction [I, II]; Digit Span), Consortium to Establish a Registry for Alzheimer's Disease (CERAD) List Learning and List Recall.

HABLE (Johnson et al., 2015; Szerlip et al., 2015)—HABLE is an ongoing epidemiological study of cognitive aging among community-dwelling Mexican Americans. HABLE utilizes a community-based participatory research (CBPR) approach that involves partnering communities to conduct studies of human disease, per our previously published protocols (O'Bryant et al., 2011). The generation of locations for targeted recruitment was determined through analysis of Texas zip codes in with the highest population density of Hispanic individuals. This research was conducted under an IRB approved protocol with each participant (and/or informants for cognitively impaired persons) providing written informed consent. Each participant underwent an interview (i.e., medical history, medications, and health behaviors), detailed neuropsychological testing, blood draw, and medical examination (review of systems, Hachinski Ischemic Index scale, brief neurological screen). Participants were provided a choice of language of test administration (English or Spanish). Consensus diagnosis of AD dementia was based on NINCDS-ADRDA criteria

(McKhann et al., 1984) and MCI per Petersen criteria (Petersen & Negash, 2008). Neuropsychological testing protocol included the AMNART or WAT, MMSE, CDR, CLOX, TMTA and TMTB, the Executive Interview (EXIT25) (Royall, Mahurin, & Gray, 1992), COWA, Animal naming, BNT, WMS-III (Logical Memory I, II; Visual Reproduction, I, II), CERAD List Learning and Delayed Recall, Rey Auditory Verbal List Learning (RAVLT) and grip strength.

Project FRONITER (Falkowski, Atchison, Debutte-Smith, Weiner, & O'Bryant, 2014; Jahn et al., 2013; Jahn et al., 2015)—Project FRONTIER was an epidemiological study of cognitive aging among rural-dwelling individuals. Similar to HABLE, recruitment was based on a CBPR approach (O'Bryant et al., 2011). CBPR is particularly useful when working with underserved communities that may not respond to classic approaches (e.g., random digit dialing, mail surveys) and is very well suited to rural health research. CBPR is supported by and recommended for rural research by the National Institute of Environmental Health Sciences (O'Fallon & Dearth, 2001). The neuropsychological test battery was comprised of the MMSE, TMTA and TMTB, EXIT25, COWA, animal naming, and RBANS.

Table 1 provides the demographic characteristics of the participants from each cohort included in the current project.

Inclusion of Participant Data

In order to be included in the normative reference studies, each participant had to meet the following criteria:

1. CDR global score of 0
2. Consensus review assignment of normal cognition

Instruments

American National Adult Reading Test ([AMNART], Grober & Sliwinski, 1991; Strauss, Spreen & Sherman, 2006) is designed to provide an estimate of premorbid intellectual ability based on an individual's capability to correctly read a presented list of words. Specifically, the test is comprised of 50 irregularly spelled words that are unable to be phonetically determined.

The Word Accentuation Test ([WAT] Krueger, Lam, & Wilson, 2006)—WAT is a pre-morbid intellectual measure for Spanish speakers that consists of a 40-item reading test based on irregular accentuation of words.

Executive Interview 25 (EXIT25), a brief 10 minute 25 item interview to assess executive impairment (Royall, Mahurin, & Gray, 1992) with a Spanish translation. Higher scores indicate greater executive impairment.

CLOX 1 & 2—CLOX (Royall, Cordes, & Polk, 1998) is a clock drawing task divided into CLOX1, a measure of executive functioning requiring subjects to draw the face of a clock with hands pointing at 1:45, with no further instruction; and CLOX2, a measure of

visuospatial/visuoconstructive abilities requiring subjects to copy the face of a clock. The Spanish version has been well validated (Royall et al. 2003).

Trail Making Test (TMT) A&B—TMTA tests visual scanning and psychomotor speed while TMTB is a measure of cognitive flexibility that requires visual scanning abilities, flexible switching between the components of the task, and the capacity to work under time pressure. The administration procedure developed by Acevedo and colleagues (Acevedo, Loewenstein, Agrón, & Duara, 2007) for Spanish-speakers was followed with pretest determination of the participant's ability to recite the alphabet. Reitan's scoring strategy was used to administer and score this test (Reitan & Wolfson, 1993), including requiring participants to self-correct under time pressure. Raw scores represent total time to completion in seconds.

Boston Naming Test (BNT), assesses stimulus-based (pictures) word retrieval. All 60 items of the BNT were administered starting with the first test stimulus. Administration and scoring for Spanish-speakers followed the procedures developed by Acevedo and colleagues (2007).

Controlled Oral Word Association (COWA)—COWA is a timed phonemic fluency task requiring the participants to produce as many words as they can begin with the letters F, A, and S in 60 seconds. Instructions for Spanish-speakers were translated by a certified translator and back translated for accuracy using the methods outlined by Fillenbaum and colleagues (Fillenbaum, Kuchibhatla, Henderson, Clark, & Taussig, 2007).

Animal Naming—Animal naming is a category fluency task requiring the participant to name all the animals they can in 60 seconds. As was the case for the semantic fluency task, instructions for the Spanish-speakers were translated by a certified translator and back translated for accuracy using the methods outlined by Fillenbaum et al. (2007).

Wechsler Memory Scale 3rd Edition ([WMS-III, Logical Memory I, II; Visual Reproduction I, II; Digit Span] Wechsler, 1997) WMS-III subscales of Logical Memory I and II consist of immediate and delayed recall of narrative information presented from two brief stories. Visual Reproductions I and II includes an assessment of non-verbal memory through immediate and delayed recall of visually presented stimuli. Digit Span subtest is a measure of working memory that requires numerical data to be repeated forwards and then backwards with increased level of difficulty. Administration and scoring for Spanish-speakers followed the procedures developed by Acevedo and colleagues (2007).

The Consortium to Establish a Registry for Alzheimer's Disease (CERAD)—CERAD list learning (Morris et al. 1989) is a brief list memory task wherein 10 items are repeated over the course of three trials with a total maximum score out of 30. Following a brief delay, the list items on the CERAD list recall trial are requested from memory evaluating retrieval of information. An additional recognition trial is administered for purposes of assessing encoding efficiencies. Administration and scoring for Spanish-speakers followed the procedures developed by Fillenbaum and colleagues (2007).

Rey Auditory Verbal Learning Task (RAVLT) (Strauss, Sherman, & Spreen, 2006)—RAVLT is a 15-item list learning task that is designed to assess verbal learning and memory. The RAVLT has been translated into multiple languages including Spanish. RAVLT enables for information regarding memory span, ability to learn new information, susceptibility to interference, and recognition memory to be evaluated (Strauss, Sherman, & Spreen, 2006). The most common version of the test utilizes 15 words that are read aloud across five consecutive trials followed by a free-recall trial. Following immediate recall, presentation of a distractor list also consisting of 15 words is provided. After a 20-minute delay, the initial list is again requested to be recalled. A recognition trial involving a list of 50 words is administered consisting of all items from the initial list as well as the distractor list in addition to words that are phonemically or semantically alike from the original and distractor lists.

None of the tests utilized here were translated specifically for this study and only previously translated versions were incorporated. Any/all instructions for Spanish-speakers were translated by a certified translator and back translated for accuracy using the methods outlined by Fillenbaum and colleagues (Fillenbaum, Kuchibhatla, Henderson, Clark, & Taussig, 2007).

Statistical Analyses

This project sought to empirically determine the optimal primary stratification variable (age, education, gender) rather than application of the previous methods for age-adjusted normative references (Patton et al., 2003; Lucas et al., 2005; Ivnik et al., 1992). In order to accomplish this, linear regression models were generated to determine the relative impact of demographic variables of age, gender, education and test language on each neuropsychological test. Once the primary stratification variable was identified, the Mayo method was utilized. That is, mid-point ranges were employed with overlapping subsamples from each stratification (Patton et al., 2003; Lucas et al., 2005).

Results

After implementation of inclusion criteria to the available databases, a total of 797 participants identified as cognitively normal were included in the present study. Of those that met inclusion criteria, data on memory specific measures were available for 653 participants. The sample was composed of 73.4% females and 412 participants who identified themselves as primarily Spanish-speakers (Table 1). The results from the linear regression models are provided in Table 2. As can be seen from Table 2, education was, by far, the strongest demographic predictor of neuropsychological test scores for the majority of tests utilized. In fact, language of administration was only entered into the regression models for a couple of tests and accounted for minimal variance once education was accounted for. Therefore, the Texas Mexican American Adult Normative Studies utilized education-stratification ranges for the primary stratification variable. The education stratification ranges were therefore 0–6 (midpoint = 3), 3–9 (midpoint = 6), 6–12 (midpoint = 9) and then 12 years and above. Next, age stratification was implemented into two groupings, 40–60 and 61 and over.

Normative references for global cognition (MMSE), intelligence (WAT, AMNART) and attention (WMS-III Digit Span) are provided in Tables 3–10. Tables 11–18 cover measures of executive functioning (CLOX, TMTA, TMTB, EXIT25) and language (COWA[FAS], Animals, BNT). Additional Tables 19–26 present normative references for select memory measures (WMS-III Logical Memory I, Logical Memory II; WMS-III Visual Reproduction I, II; CERAD Immediate Memory, Delayed Memory; RAVLT Trail 1–5, List B, Immediate [3 minute] recall, Delayed Recall [20 minute], and Recognition). Data on performance on the RAVLT was available only for HABLE participants.

Discussion

Results for the current sample of Texas-based Mexican Americans found that education was the demographic factor that accounted for the greatest amount of variance in neuropsychological test scores. Therefore, the normative references were created by means of education-stratification rather than the prototypical age-stratified ranges. This is consistent with findings from larger epidemiological samples that include both English and Spanish speakers who have identified significant educational effects particularly among those who are Spanish speakers (Ardila, Ostrosky-Solis, Rosselli, Gomez, 2000; Ponton et al., 1996; Mack et al., 2005; Pineda et al., 2000; Acevedo et al., 2007; Stricks, Pittman, Jacobs, Sano, Stern, 1998). Such studies have also indicated that age and gender were less salient for Spanish speaking populations and only impacted some of the tests sampled (Stricks, Pittman, Jacobs, Sano, Stern, 1998; Ardila, Ostrosky-Solis, Rosselli, & Gomez, 2000; Ponton et al., 1996; Mack et al., 2005; Pineda et al., 2000; Acevedo et al., 2007). Given the non-linear impact of education on cognitive test performance, it is possible that the driving education based stratification is due to the overall lower educational attainment of the current cohort as compared to most prior normative references, which is consistent with the Mexican American U.S. population.

Studies have shown that low education can lower test performance specifically on language based measures such as confrontational naming tests (Manly, Jacobs, Sano et al., 1999). Literature has implicated that discrepancies in test results among those with low education as well as of Hispanic background could be related to the cultural relevance of test stimuli, task requirements, and possibly even bilingualism (Ardila 1995; Gollan, Fennema-Notestine, Montoya, Jernigan 2007; Rosselli, Ardila, Jurado, Salvatierra 2012; Roberst, Garcia, Desrochers, Hernandez, 2002). Additional work is ongoing within our team to better determine and define the inflection points where education increases and decreases risk for cognitive loss. To date, these are to our knowledge the first such educationally stratified normative references in this population. It is suggested that the education-stratification method be considered and empirically tested in future normative studies in this population. In fact, we generated age-adjusted normative references, which did not appear clinically appropriate upon examination. These methods will be validated against an independent sample of community-dwelling Mexican Americans currently being recruited.

Past efforts to establish normative references for Spanish speakers have been conducted primarily among sample cohorts of young adults (Campo, Morales, & Juan-Malpartida, 2000; Pineda et al., 2000; Rey, Feldman, Rivas-Vazquez, Levin, Benton, 1999). Few Spanish

speaking normative references have been generated for those considered to be older adults (>65 years old) and limitations of the data include small sample size (Artiola i Fortuny, Heaton, Hermosillo, 1998; Ponton et al., 1996), exclusively monolingual (English) as compared to bilingual (Ostrosky-Solis, Ardila & Rosselli, 1999; Pineda et al., 2000), or inclusion of individuals of Latino decent who speak primarily English as compared to primarily Spanish (Gonzalez, Mungas, Hann, 2002; La Rue, Romero, Ortiz, Liang, Lindeman, 1999). To date, few Mexican American normative references for individuals residing in the U.S. have been established as compared to references of those residing in Latin American Countries (Ostrosky-Solis, Ardila & Rosselli, 1999; Pineda et al., 2000) or in European countries such as Spain (Artiola i Fortuny, Heaton, Hermosillo, 1998; Benito-Cuadrado, Esteba-Castillo, Bohm, Cejudo-Bolivar, & Pena-Casanova, 2002).

As a component of a larger study, limited normative data has been derived on older Spanish speakers in the U.S. (18 English Speakers, 18 Spanish Speakers) (Taussig, Henderson, & Mack, 1992). The results of this study and others (Taussig, Henderson, & Mack, 1992; Jacobs et al., 1997) found among cognitively normal older adults that even after adjusting for demographics (age, education), English speakers outperformed Spanish speaking counterparts on measures of language (BNT, Boston Diagnostic Aphasia Examination, COWA), working memory (Arithmetic test[WAIS-III]) and visual memory (Benton Visual Retention Test [BVRT]). Lopez & Taussig (1991) found in their study that despite the use of corresponding Spanish translated measures, when English speaking normative data was applied for purposes of scoring that even among cognitively normal older adult U.S. Spanish speakers, there was an underestimation of their level of cognitive impairment and increase in the rate of false positives. Variability in English versus Spanish speaking adults and elders on neuropsychological test performance was suggested as being possibly related to years of residence in the U.S., U.S. based education, generation status, bilingualism, acculturation, and possibility even due to age of arrival to the U.S. (Acevedo, Loewenstein, Barker, Harwood, Luis, Bravo, 2000; Artiola i Fortuny, Heaton, Hermosillo, 1998; Coffey, Marmol, Schock, & Adams, 2005; Acevedo et al., 2007).

Prior work has suggested that Hispanics may be at increased risk for Alzheimer's disease and cognitive dysfunction at significantly younger ages (O'Bryant et al., 2013b). However, it remains to be determined if this prevalence difference is due to a true health disparity or inadequate/inaccurate assessment procedures. It should be noted that these norms are specific to Mexican Americans and should not be used with other Hispanic populations (i.e. Puerto Ricans, Cuban, and Dominican Republic). The Hispanic group is made of a wide variety of subgroups that can have marked differences in ethnicity, culture, origin, and dialects. Therefore, use of these norms with Hispanics that are not Mexican American could affect interpretation of test results, compromising validity of the assessment.

Recent research by Boone and colleagues (2007) has suggested that cognitive performance in differing ethnicities is affected by factors of acculturation, including whether subjects learned English as a first language or at the same time as their other language as opposed to English learned as a second language; the age when English was first learned; number of year resided in the US; and the number of years educated in the US. A limitation of our study was that this information was not available to us, either by the factors noted above or

by use of a formal measure of acculturation. Additionally, this study was limited by not having a formal assessment of bilingualism or language fluency. Another limitation to the study includes the relatively small sample size in select cells of the normative tables. The current group is working to increase the normative references as well as provide longitudinal assessments to determine the stability of the normative references once those who decline are removed. However, the provision of these normative references is a significant step towards addressing this question as well as meeting the needs of currently practicing neuropsychologists.

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Table 1

Demographics across cohorts

	Total N=797	HABLE n=387	FRONTIER n=144	TARCC n=266
Age	60.4 (8.6)	59.2 (6.8)	53.8 (9.1)	65.8 (7.4)
Education	9.9 (4.6)	8.5 (4.3)	8.1 (4.0)	12.9 (3.9)
% female	73.4	79.3	77.1	62.8
% Spanish-speaker	51.7	76.5	48.6	17.3
% diagnosis HTN	61.0	66.9	54.2	62
% diagnosis DM	34.6	39.5	30.6	33.8
% diagnosis depression	20.7	36.4	25.7	0
MMSE	27.4 (5.5)	26.7 (2.6)	27.6 (2.5)	28.5 (1.9)
WAT	18.1 (6.2)	18.1 (6.2)	-	17 (5.5)
AMNART	24.3 (12.5)	26.5 (9.1)	34.1 (11.3)	18.7 (10.7)
WMS-III Digit Span	12.2 (3.4)	11.1 (2.9)	-	13.8 (3.4)

Table 2

Stratified linear regression models

Test		B(Std Error)	t-score	p-value	R ²
CLOX1	Education	.11(.02)	5.63	<0.001	.08
	Age	-.03(.01)	-2.77	=0.006	.02
CLOX2	Education	.13(.02)	7.93	<0.001	.14
EXIT25	Education	-.49(.10)	-4.98	<0.001	.27
	Gender	-1.96(.95)	-2.07	=0.04	.04
Animals	Education	.31(.04)	7.66	<0.001	.12
	Age	-.08(.02)	-4.04	<0.001	.03
MMSE	Education	.22(.07)	3.28	=0.002	.14
	Gender	1.96(.64)	3.06	=0.003	.09
TMT A	Education	-2.21(.23)	-9.53	<0.001	.30
	Age	.55(.09)	6.01	<0.001	.05
	Test Language	9.45(2.67)	3.55	<0.001	.02
	Gender	-3.73(1.84)	-2.03	=0.04	.01
TMT B	Education	-7.67(.50)	-15.22	<0.001	.32
	Age	1.42(.22)	6.31	<0.001	.07
FAS	Gender	11.24(4.64)	-2.43	=0.02	.01
	Age	-.32(.05)	-6.81	<0.001	.11
CERAD LL	Education	.37(.06)	6.06	<0.001	.22
	Test Language	-3.93(.77)	-5.11	<0.001	.05
	Age	-.11(.03)	-3.82	<0.001	.03
	Gender	1.66(.45)	3.69	<0.001	.03
WMS-III DS	Education	.41(.04)	11.78	<0.001	.30
WMS-III LM I	Education	.79(.10)	7.59	<0.001	.14
	Gender	2.63(.99)	2.66	=0.008	.02
WMS-III LM II	Education	.50(.08)	6.46	<0.001	.11
	Gender	2.32(.74)	3.15	=0.002	.03
WMS-III VR I	Age	-.10(.05)	-2.28	=0.02	.01
	Education	1.06(.20)	5.05	<0.001	.19

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Test		B(Std Error)	t-score	p-value	R ²
WMS-III VR II	Age	-.41(.10)	-4.22	<0.001	.05
	Education	1.62(.22)	7.56	<0.001	.15
CERAD LR	Age	-.66(.13)	-5.24	<0.001	.07
	Education	.12(.03)	4.43	<0.001	.15
	Age	-.06(.01)	-4.61	<0.001	.05
	Gender	.67(.20)	3.33	=0.001	.03
BNT	Test Language	-.90(.34)	-2.61	=0.009	.02
	Education	.93(.11)	8.32	<0.001	.28
	Age	-.17(.05)	-3.60	<0.001	.04
	Education	-1.24(.14)	-9.04	<0.001	.14
WAT	Education	.40(.11)	3.60	<0.001	.08

Table 3

Scaled Scores: ages from 40 to 60 and years of education from 0 to 6

Scaled score	MMSE World	WAT	AMNART	WMS-III Digit Span
19				
18		27-30		16-30
17		26		15
16		25	0-21	14
15	30		22-28	13
14	29	24	29-30	
13		21-23	31-33	12
12	28	18-20	40	11
11	27	16-17	45	10
10	26	14-15		9
9	25	11-13		
8	24	10		8
7	22-23	9		6-7
6	21	7-8		
5	20	4-6		5
4		3		
3	18-19	0-2		4
2	0-17			0-3
1				
Type of score for each test				
Sample size (n)	Correct Count	Correct Count	Correct Count	Correct Count
	141	93	29	102

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Table 4

Scaled Scores: ages 61+ and years of education from 0 to 6

Scaled score	MMSE World	WAT	AMNART	WMS-III Digit Span
19				
18		28-30		15-30
17	30	26-27		14
16	29		0-11	13
15	28	24-25	12-23	
14		22-23	24-27	12
13		21	28-32	11
12	27	19-20	33	10
11	26	17-18	35-36	9
10	24-25	15-16	38-43	
9	23	11-14	44-45	8
8	21-22	9-10		
7	20	8		7
6	19	6-7		6
5	17-18	5		5
4		3-4		
3	16	0-2		4
2	0-15			0-3
1				

Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (<i>n</i>)	109	60	22	90

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Table 5

Scaled Scores: ages from 40 to 60 and years of education from 3 to 9

Scaled score	MMSE World	WAT	AMNART	WMS-III Digit Span
19				20–30
18				16–17
17			0–13	15
16		27–30	14	14
15	30	25–26	15–19	13
14	29	24	20–21	12
13		22–23	22–27	11
12	28	19–21	28–31	10
11	27	17–18	32–36	9
10		15–16	37–38	8
9	25–26	13–14	39–44	7
8		10–12	45	6
7	23–24	9		5
6	22	7–8		4
5	20–21	4–6		
4		3		
3	18–19	0–2		
2	0–17			
1				
Type of score for each test				
Sample size (<i>n</i>)	Correct Count	Correct Count	Correct Count	Correct Count
	202	121	63	144

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Table 6

Scaled Scores: ages 61+ and years of education from 3 to 9

Scaled score	MMSE World	WAT	AMNART	WMS-III Digit Span
19				
18		29-30		
17	30	28		15-30
16	29	27	0-11	13-14
15		26	12-21	
14	28	24-25	22-23	12
13		22-23	24-26	11
12	27	20-21	27-28	
11		18-19	29-32	10
10	26	17	33-34	9
9	25	15-16	35-38	8
8	23-24	11-14	39-43	
7	21-22	8-10	44	7
6	20		45	
5	19	5-7		5-6
4	17-18	3-4		0-4
3	16	0-2		
2	0-15			
1				
Type of score for each test				
Sample size (n)	Correct Count	Correct Count	Correct Count	Correct Count
	115	57	35	97

Table 7

Scaled Scores: ages from 40 to 60 and years of education from 6 to 12

Scaled score	MMSE World	WAT	AMNART	WMS-III Digit Span
19				
18		28-30	0-6	20-30
17		27	7-9	17-19
16			10-11	
15		26	12-13	15-16
14	30	25	14-16	14
13	29	24	17-21	13
12		21-23	22-23	12
11	28	19-20	24-27	
10	27	17-18	28-32	11
9		15-16	33-36	10
8	26	12-14	37-40	9
7	25	11	41-44	
6	24	10	45	8
5	22-23	7-9		7
4	21	0-6		6
3	20			5
2	0-19			0-4
1				

Type of score for each test	Correct Count	Correct Count	Correct Count
Sample size (<i>n</i>)	258	118	123
			179

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Table 8

Scaled Scores: ages 61+ and years of education from 9 to 12

Scaled score	MMSE World	WAT	AMNART	WMS-III Digit Span
19				21–30
18				18–20
17		29–30	0–5	17
16		28	6	15–16
15		27		
14	30	26	7–10	
13	29	24–25	11–13	14
12	28	22–23	14–18	13
11		21	19–21	12
10	27	20	22–25	11
9		17–19	26–30	10
8	26	15–16	31–33	9
7	24–25	11–14	34–37	8
6	23	9–10	38–42	7
5	21–22	8	43–44	
4	20	0–7	45	
3	19			6
2	0–18			0–5
1				

Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (<i>n</i>)	177	49	116	162

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Table 9

Scaled Scores: ages from 40 to 60 and years of education 12+

Scaled score	MMSE World	WAT	AMNART	WMS-III Digit Span
19				
18		30		23–30
17		29	0–1	20–22
16		28	2	
15		27	3–4	19
14			5–7	17–18
13	30	25–26	8–11	16
12	29	24	12–14	15
11		23	15–16	14
10	28	21–22	17–20	12–13
9		19–20	21–23	
8	27	17–18	24	11
7		14–16	25–29	10
6	26	13	30–33	9
5	25	12	34–38	
4	24	10–11	39–44	
3	23	0–9	45	8
2	0–22			0–7
1				
Type of score for each test				
Sample size (<i>n</i>)	Correct Count	Correct Count	Correct Count	Correct Count
	161	46	106	124

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Table 10

Scaled Scores: ages 61+ and years of education from 12+

Scaled score	MMSE World	WAT	AMNART	WMS-III Digit Span
19				23–30
18				21–22
17				20
16		29–30	0–1	18–19
15		28	2–3	17
14		27	4–5	16
13	30		6	15
12	29	26	7–8	14
11		22–25	9–12	13
10		21	13–17	12
9	28	20	18–19	11
8		18–19	20–24	10
7	27	15–17	25–28	9
6	26	11–14	29–31	8
5	25	0–10	32–35	6–7
4		36–39		0–5
3	23–24	40		
2	0–22	41–45		
1				
Type of score for each test				
Sample size (<i>n</i>)	Correct Count	Correct Count	Correct Count	Correct Count
	217	169	194	211

Table 11

Scaled Scores: ages from 40 to 60 and years of education from 0 to 6

Scaled score	TMT-A	TMT-B	CLOX 1	CLOX 2	EXIT-25	FAS	Animal	Boston Naming
19								
18	21	51	15			47	27	58-60
17	22-24	52-56	14			42-46	26	55-57
16	25-28	57-70			0-1	40-41	23-25	
15	29-34	71-80			2	36-39	21-22	52-54
14	35-37	81-86	13	15		33-35	20	49-51
13	38-41	87-99		14	3	29-32	18-19	46-48
12	42-45	100-109	12		4-5	25-28	16-17	43-45
11	46-52	110-122	11		6	23-24		40-42
10	53-58	123-153		13	7	21-22	14-15	38-39
9	59-62	154-184	10		8	17-20	13	36-37
8	63-71	185-209	9	12	9-10	15-16	12	34-35
7	72-77	210-252	8		11-12	13-14	11	32-33
6	78-89	253-299		11	13	11-12	10	26-31
5	90-104	300	6-7		14	9-10	8-9	20-25
4	105-120				15-17	7-8		19
3	121-138		3-5	10	18	5-6	6-7	17-18
2	139		0-2	0-9	19-25	0-4	0-5	0-16
1								
Type of score for each test								
Sample size (n)	136	112	140	139	108	138	139	120

Table 12

Scaled Scores: ages from 61+ and years of education from 0 to 6

Scaled score	TMT-A	TMT-B	CLOX 1	CLOX 2	EXIT-25	FAS	Animal	Boston Naming
19						45	24	54-60
18	26	73				38-44	23	52-53
17	27-29	74-84	14-15		0-1			51
16	30-32		13	15	2-3	37	21-22	48-50
15	33-37	85-98		14	4	34-36	19-20	47
14	38-41	99-115			5	31-33	17-18	45-46
13	42-46	116-143	12		6	28-30	15-16	40-44
12	47-54	144-154			7	24-27	14	37-39
11	55-59	155-180	11	13	8-9	21-23	13	34-36
10	60-65	181-201		12	10	17-20	11-12	29-33
9	66-77	202-233	10		11	15-16		27-28
8	78-98	234-254	9	11	12	12-14	9-10	22-26
7	99-109	255-299	8		13	10-11	8	20-21
6	110-128	300			14-16	8-9	7	19
5	129-149		6-7	9-10	17-18	4-7		16-18
4	150		0-5	8	19		6	15
3				0-7	20	3	0-5	0-14
2					21-25	0-2		
1								

Type of score for each test	Seconds to complete	Seconds to complete	Correct Count	Correct Count	Incorrect Count	Correct Count	Correct Count	Correct Count
Sample size (n)	104	73	106	107	64	101	104	91

Table 13

Scaled Scores: ages from 40 to 60 and years of education from 3 to 9

Scaled score	TMT-A	TMT-B	CLOX 1	CLOX 2	EXIT-25	FAS	Animal	Boston Naming
19								
18	21	43	15		0	45	27	58-60
17	22-24	44-56	14		1	42-44	25-26	55-56
16	25-26	57-58				40-41	22-24	
15	27-28	59-71				36-39	20-21	52-54
14	29-33	72-80		15	2	34-35	19	50-51
13	34-36	81-90	13	14	3	31-33	18	48-49
12	37-40	91-99	12		4	27-30	17	45-47
11	41-45	100-109			5	25-26	16	43-44
10	46-51	110-121	11	13	6	22-24	15	40-42
9	52-58	122-145			7	18-21	14	37-39
8	59-63	146-180	10	12	8-9	16-17	12-13	35-36
7	64-71	181-209	9		10	14-15	11	33-34
6	72-77	210-252	8	11	11-12	13	10	29-32
5	78-87	253-299	6-7		13-14	9-12	9	23-28
4	88-96	300	5		15		8	20-22
3	97-120		3-4	10	16-18	3-8	6-7	17-19
2	121-138		0-2	0-9	19-25	0-2	0-5	0-16
1	139							

Type of score for each test	Seconds to complete	Seconds to complete	Correct Count	Correct Count	Incorrect Count	Correct Count	Correct Count	Correct Count
Sample size (n)	199	173	203	202	146	202	202	171

Table 14

Scaled Scores: ages from 61+ and years of education from 3 to 9

Scaled score	TMT-A	TMT-B	CLOX 1	CLOX 2	EXIT-25	FAS	Animal	Boston Naming
19								
18	25	73			0-1	46	24	55-60
17	26	74-77	14-15		2	38-45	23	52-54
16	27-29	78-82	13			37	21-22	
15	30-36	83-93		15	3	35-36	20	51
14	37-39	94-106		14	4	32-34	18-19	48-50
13	40-42	107-129			5	29-31	17	46-47
12	43-47	130-143	12		6	25-28	16	42-45
11	48-55	144-154		13	7	23-24	14-15	39-41
10	56-59	155-185	11		8-9	19-22	13	36-38
9	60-66	186-206		12	10	16-18	12	33-35
8	67-79	207-233	10		11	15	11	27-32
7	80-96	234-261	8-9	11	12	13-14	10	23-26
6	97-114	262-299	7		13-14	11-12	9	21-22
5	115-132	300	6	9-10	15-16	9-10	7-8	19-20
4	133-149		5	8	17-19	6-8	0-6	16-18
3	150		0-4	0-7	20	4-5		15
2					21-25	0-3		0-14
1								
Type of score for each test								
Sample size (n)	110	95	111	112	71	112	114	98

Table 15

Scaled Scores: ages from 40 to 60 and years of education from 6 to 12

Scaled score	TMT-A	TMT-B	CLOX 1	CLOX 2	EXIT-25	FAS	Animal	Boston Naming
19	17	41						
18	18–20	42–43				50	27	59–60
17	21	44–51	15			47–49	26	56–58
16	22–23	52–54	14			44–46	25	55
15	24	55–59			0	40–43	22–24	54
14	25–28	60–68		15	1	36–39	20–21	52–53
13	29–31	69–75	13	14	2	34–35	19	50–51
12	32–35	76–85			3	30–33	18	48–49
11	36–39	86–96	12		4	27–29	16–17	45–47
10	40–44	97–108			5	24–26	15	43–44
9	45–49	109–116	11	13	6–7	21–23	14	40–42
8	50–55	117–143			8	19–20	13	39
7	56–63	144–177	10	12	9–10	16–18	12	36–38
6	64–72	178–210	9		11–12	14–15	11	33–35
5	73–77	211–252	8	11	13	12–13	9–10	31–32
4	78–82	253–274	7		14–15	11	8	29–30
3	83–120	275–299	6		16–18	9–10	7	20–28
2	121	300	5	10	19–25	3–8	6	0–19
1			0–4	0–9		0–2	0–5	
<hr/>								
Type of score for each test	Seconds to complete	Seconds to complete	Correct Count	Correct Count	Incorrect Count	Correct Count	Correct Count	Correct Count
Sample size (<i>n</i>)	256	240	258	258	175	259	259	211

Table 16

Scaled Scores: ages from 61+ and years of education from 6 to 12

Scaled score	TMT-A	TMT-B	CLOX 1	CLOX 2	EXIT-25	FAS	Animal	Boston Naming
19								
18	16	42	15			53	35	58-60
17	17-20	43-46	14			48-52	22-34	56-57
16	21-23	47-60			0	45-47	21	55
15	24-25	61-65			1-2	43-44	20	53-54
14	26-27	66-73	13	15	3-4	38-42	19	51-52
13	28-33	74-84		14		34-37	18	50
12	34-38	85-101			5	31-33	17	46-49
11	39-41	102-114	12		6	27-30	15-16	43-45
10	42-48	115-132		13	7	23-26	14	41-42
9	49-54	133-148	11		8-9	20-22	13	37-40
8	55-60	149-176		12	10-11	18-19	12	34-36
7	61-67	177-205	9-10		12	16-17		30-33
6	68-80	206-231	8	11	13	14-15	11	27-29
5	81-96	232-278	7		14	12-13	9-10	22-26
4	97-114	279-299			15	9-11	8	20-21
3	115-149	300	5-6	10	16-18	6-8	7	0-19
2	150		0-4	0-9	19-25	0-5	0-6	
1								
Type of score for each test								
Sample size (n)	173	165	169	170	69	177	175	113

Table 17

Scaled Scores: ages from 40 to 60 and years of education from 12+

Scaled score	TMT-A	TMT-B	CLOX 1	CLOX 2	EXIT-25	FAS	Animal	Boston Naming
19								
18	13	36				66	28	60
17	14-15	37-38				52-65	27	59
16	16-17	39-40	15			50-51	26	
15	18-20	41-46	14		0	48-49	25	57-58
14	21-22	47-51			1	44-47	23-24	55-56
13	23-24	52-57		15	2	40-43	21-22	54
12	25-26	58-62	13	14		36-39	20	52-53
11	27-31	63-71			3	33-35	18-19	50-51
10	32-37	72-82	12		4	29-32	17	49
9	38-41	83-87		13	5	27-28	15-16	47-48
8	42-46	88-102	11		6	23-26		44-46
7	47-52	103-115			7	21-22	13-14	43
6	53-62	116-127	10		8	19-20	12	40-42
5	63-67	128-147		12	9	17-18	10-11	39
4	68-74	148-190	9	0-11	10	16	9	37-38
3	75-111	191-247	4-8		11-13	12-15	7-8	32-36
2	112	248	0-3		14-25	0-11	0-6	0-31
1								
Type of score for each test	Seconds to complete	Seconds to complete	Correct Count	Correct Count	Incorrect Count	Correct Count	Correct Count	Correct Count
Sample size (<i>n</i>)	160	156	158	158	78	160	159	108

Table 18

Scaled Scores: ages from 61+ and years of education from 12+

Scaled score	TMT-A	TMT-B	CLOX 1	CLOX 2	EXIT-25	FAS	Animal	Boston Naming
19								
18	16	39				59	25	
17	17-18	40-44				53-58	23-24	60
16	19-20	45-47				51-52	22	58-59
15	21-22	48-52	15		0	48-50	21	57
14	23-24	53-57	14		1-2	44-47	20	55-56
13	25-27	58-64	13	15	3	41-43	19	54
12	28-29	65-71		14	4-5	39-40	17-18	52-53
11	30-33	72-79			6	34-38		49-51
10	34-37	80-91	12		7	32-33	16	47-48
9	38-41	92-104		13	8	28-31	15	43-46
8	42-45	105-118	11		9	24-27	13-14	41-42
7	46-52	119-137	10		10	20-23	12	35-40
6	53-58	138-160	9	12	11-12	19		30-34
5	59-70	161-185	7-8		13	17-18	11	29
4	71-75	186-208	5-6	11	14-15	16	10	
3	76-89	209-226	4	10	16-25	9-15	7-9	20-28
2	90	227	0-3	0-9		0-8	0-6	0-19
1								
Type of score for each test								
Sample size (n)	216	216	201	200	33	217	211	73

Table 19

Scaled Scores: ages from 40 to 60 and years of education from 0 to 6

Scaled score	WMS-III Logical Memory I	WMS-III Logical Memory II	WMS-III Visual Reproduction I	WMS-III Visual Reproduction II	CERAD Immediate Memory	CERAD Delayed Memory	RAVLT Trial 1	RAVLT Trial 2	RAVLT Trial 3	RAVLT Trial 4	RAVLT Trial 5	RAVLT List B	RAVLT 3 minute Recall	RAVLT 20 minute Recall	RAVLT Recognition
19															
18	54-75	39-50	92-104	83-104	25-30	9-10	9-15	12-15		15		9-15			
17	52	36-38	91	78-82	24		8	11		14	15	8			
16	50-51		90	72-77	23	8	7		13-15		14		14-15		
15	48-49	34-35	82-89	63-71				10	12			7	13	13	
14	43-47	28-33	78-81	55-62	21-22	7			11	13	13	6	12	12	
13	40-41	25-27	73-77	47-54	20		6	9		12		5	11	11	15
12	35-39	22-24	70-72	39-46	18-19	6	5	8	10	11	12	4	10	10	14
11	32-34	19-21	63-69	36-38	17	5			9		11		8-9	9	
10	28-31	17-18	59-62	29-35	16		4	7		10	10			8	
9	24-27	14-16	57-58	23-28	14-15	4		6	7-8	8-9		3		7	13
8	21-23	12-13	52-56	16-22	13		3				9	2	7	6	
7	18-20	11	47-51	13-15		3		5	6	7			6		12
6	16-17	9-10	39-46	9-12	11-12	2	2		5	6			5	5	
5	13-15	8	35-38	6-8	10	1	0-1	4	4	4-5	7-8	1	3-4	4	10-11
4		7		5	9	0			0-3					0-3	0-9
3	12	6	29-34	2-4	8			3		3	5-6	0	0-2		
2	0-11	0-5	0-28	0-1	0-7			0-2		0-2	0-4				
1															
Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (n)	100	100	84	84	99	98	75	75	75	75	75	75	75	75	75

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Table 20

Scaled Scores: ages 61+ and years of education from 0 to 6

Scaled score	WMS-III Logical Memory I	WMS-III Logical Memory II	WMS-III Visual Reproduction I	WMS-III Visual Reproduction II	CERAD Immediate Memory	CERAD Delayed Memory	RAVLT Trial 1	RAVLT Trial 2	RAVLT Trial 3	RAVLT Trial 4	RAVLT Trial 5	RAVLT List B	RAVLT 3 minute Recall	RAVLT 20 minute Recall	RAVLT Recognition
19															
18	47-75	33-50	88-104	63-104	25-30	10		11-15	13-15	14-15			14-15		
17	46	31-32	87	57-62		9		10	12	13	15	8-15	13		
16	45	29-30	85-86	54-56	21-24	7-8					14	7		13-15	
15	44	27-28	79-84	44-53	20		7-15		11	12	13	6	11-12	12	
14	42-43	24-26	74-78	38-43	19		6	9			12	5		11	
13	36-41	22-23	70-73	34-37	18	6	5		10	11	11		10	10	15
12	33-35	19-21	64-69	30-33	17			8		10		4	9	9	14
11	30-32	17-18	56-63	26-29	16	5		7	9	9	10		8		
10	27-29	14-16	51-55	22-25	15	4	4	6	8			3		8	13
9	23-26	11-13	47-50	17-21	14	3			7	8	9		7	7	
8	20-22	9-10	41-46	15-16	13		3	5	6	7	8	2	6	6	12
7	16-19	8	37-40	13-14	11-12	2	2				7		5	5	11
6	13-15	7	35-36	11-12			0-1	4	5				4	4	
5	10-12	6	30-34	8-10	9-10	1				6	6		3	3	10
4	8-9	4-5						3	4	5	5	1	2	2	9
3	7	2-3	28-29	0-7	8	0		0-2	0-3	0-4	0-4		0-1	0-1	0-8
2	0-6	0-1	0-27		0-7										
1															
Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (n)	88	88	73	72	78	78	48	48	48	48	48	48	48	48	48

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Table 21

Scaled Scores: ages from 40 to 60 and years of education from 3 to 9

Scaled score	WMS-III Logical Memory I	WMS-III Logical Memory II	WMS-III Visual Reproduction I	WMS-III Visual Reproduction II	CERAD Immediate Memory	CERAD Delayed Memory	RAVLT Trial 1	RAVLT Trial 2	RAVLT Trial 3	RAVLT Trial 4	RAVLT Trial 5	RAVLT List B	RAVLT 3 minute Recall	RAVLT 20 minute Recall	RAVLT Recognition
19															
18	54-75	39-75	96-104	78-104	26-30	10	9-15	14-15	14-15	15		9-15			
17	50-53	36-37	92-95	73-77	24-25	9	8	12-13	13	14	15	8		14-15	
16	49	35	87-91	70-72				11			14	7	14-15	13	
15	47-48	31-34	85-86	63-69	23	8	7		12				13		
14	43-46	28-30	79-84	58-62	22			10		13	13	6	11-12	12	
13	40-42	25-27	77-78	47-57	21	7	6	9	11	12				11	
12	36-39	23-24	71-76	39-46	19-20	6			10	11	12	5	10	10	15
11	33-35	20-22	69-70	34-38	18		5	8			11	4	8-9	9	14
10	29-32	17-19	63-68	28-33	17	5	4	7	9	10	10			8	
9	26-28	15-16	60-62	23-27	15-16	4		6	8	9		3	7	7	13
8	23-25	12-14	56-59	19-22	14		3	5	7	8	9	2		6	
7	19-22	11	50-55	15-18	13				6	7			6	5	12
6	16-18	9-10	47-49	9-14	12	2-3					8		5		
5	13-15	8	40-46	6-8	10-11	1	2	4	5	5-6	7	1			10-11
4		7	35-39				0-1			4		0	3-4	4	0-9
3	5-12	0-6	0-34	2-5	8-9	0		3	4	3	5-6		0-2	0-3	
2	0-4			0-1	0-7			0-2	0-3	0-2	0-4				
1															
Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (n)	142	142	114	114	142	141	93	93	93	93	93	93	93	93	93

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Table 22

Scaled Scores: ages 61+ and years of education from 3 to 9

Scaled score	WMS-III Logical Memory I	WMS-III Logical Memory II	WMS-III Visual Reproduction I	WMS-III Visual Reproduction II	CERAD Immediate Memory	CERAD Delayed Memory	RAVLT Trial 1	RAVLT Trial 2	RAVLT Trial 3	RAVLT Trial 4	RAVLT Trial 5	RAVLT List B	RAVLT 3 minute Recall	RAVLT 20 minute Recall	RAVLT Recognition
19															
18	48-75	32-75	88-104	68-104		10		12-15		14-15			14-15		
17	47	31	84-87	62-67	25	9	8-15	11	13-15	13	15	8-15	13		
16	46	30		57-61	24	8	7	10	12		14	7			
15	44-45	28-29	79-83	54-55	21-23	7						6	12	13-15	
14	42-43	25-27	74-78	44-53	20		6	9	11	12	13	5	11	12	
13	38-41	22-24	72-73	39-43						11			10	11	15
12	35-37	19-21	67-71	33-38	18-19	6	5	8	10		11	4	9	9-10	14
11	32-34	17-18	57-66	28-32	17	5		7	9	10				8	
10	27-31	14-16	55-56	23-27	16		4	6		9	10	3	8	7	
9	23-26	12-13	49-54	18-22	14-15	4			7-8	8	9		7		13
8	20-22	9-11	43-48	14-17	13	3	3	5	6	7	8	2	6	6	12
7	16-19	8	39-42	11-13	12	2					7		5	5	11
6	13-15	7	36-38	8-10	11		2	4	5	6			4	4	
5	10-12	5-6	34-35	6-7		1				5	6				10
4	8-9	4			9-10		1	3	4	4	5	1	2-3	2-3	9
3	7	2-3	30-33	0-5	8	0	0	0-2	0-3	0-3	0-4	0	0-1	0-1	0-8
2	0-6	0-1	0-29		0-7										
1															
Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (n)	95	95	84	84	91	91	56	56	56	56	56	56	56	56	56

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Table 23

Scaled Scores: ages from 40 to 60 and years of education from 6 to 12

Scaled score	WMS-III Logical Memory I	WMS-III Logical Memory II	WMS-III Visual Reproduction I	WMS-III Visual Reproduction II	CERAD Immediate Memory	CERAD Delayed Memory	RAVLT Trial 1	RAVLT Trial 2	RAVLT Trial 3	RAVLT Trial 4	RAVLT Trial 5	RAVLT List B	RAVLT 3 minute Recall	RAVLT 20 minute Recall	RAVLT Recognition
19															
18	61–75	39–75	96–104	79–104	27–30		9–15	14–15	14–15	15				15	
17	50–60	36–38	91–92	74–78	25–26		8	12–13	13	14	15			14	
16	49	32–35	87–90	72–73		10	7		12		14	8–15	14–15	13	
15	47–48	30–31		65–71	24	9		11		13		7	13	12	
14	44–46	29	82–86	59–64	23	8		10			13		11–12		
13	40–43	26–28	78–81	51–58	22	7	6		11	12		6		11	
12	37–39	24–25	75–77	46–50	20–21			9	10		12	5	10	10	15
11	34–36	22–23	72–74	39–45	19	6	5	8		11		4	9	9	14
10	31–33	18–21	68–71	33–38	18			7	9	10	11		8		
9	28–30	16–17	64–67	27–32	16–17	5	4		8	9	10	3		8	13
8	25–27	13–15	61–63	22–26	15	4		6		8	9		7	7	
7	22–24	11–12	56–60	18–21	14		3	5	7		8	2	6	6	12
6	18–21	10	50–55	9–17	13	3			6	7					10–11
5	15–17	8–9	45–47	6–8	12	1–2	2	4		6	6–7		5	5	
4	13–14		41–44	0–5	11		0–1			5		1	3–4	4	9
3	5–12	0–7	40		8–10	0		3	5	4	5	0	0–2	0–3	8
2	0–4		0–39		0–7			0–2	0–4	0–3	0–4				0–7
1															
Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (<i>n</i>)	178	178	136	136	177	176	100	100	100	100	100	100	100	100	100

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Table 24

Scaled Scores: ages 61+ and years of education from 6 to 12

Scaled score	WMS-III Logical Memory I	WMS-III Logical Memory II	WMS-III Visual Reproduction I	WMS-III Visual Reproduction II	CERAD Immediate Memory	CERAD Delayed Memory	RAVLT Trial 1	RAVLT Trial 2	RAVLT Trial 3	RAVLT Trial 4	RAVLT Trial 5	RAVLT List B	RAVLT 3 minute Recall	RAVLT 20 minute Recall	RAVLT Recognition
19															
18	56-75	36-75	96-104	79-104	28-30			12-15				7-15	13-15		
17	48-51	32-35	91-95	74-78	26-27	10		10		13-15		6	12		
16	47	31	89-90	67-73	25	9	8-15		13-15	12				13-15	
15	45-46	30	86-88	60-66	24		7	9	11-12		14-15	5		12	
14	43-44	28-29	79-85	56-59	23	8	6		10	11	12-13		11	11	15
13	40-42	25-27	75-78	49-55	21-22			8				4	10	10	14
12	37-39	23-24	71-74	43-48	20	7	5			10	11		9	9	
11	34-36	21-22	67-70	37-42	19	6		7	9	9					
10	31-33	18-20	63-66	30-36	17-18	5	4	6	8		10		8	7-8	13
9	28-30	15-17	55-62	23-29	16					8	9	3	7	6	
8	25-27	13-14	51-54	17-22	15	4	3	5	7	7	8	2	5-6		12
7	20-24	10-12	45-50	14-16	13-14	3			6	6	7		4	5	
6	17-19	9	37-44	11-13	12		2	4	5					4	11
5	15-16	7-8	34-36	7-10	11	2	1		0-4	5	6	1	2-3		0-10
4		6		6			0	3		4	5	0	0-1	2-3	
3	10-14	5	30-33	0-5	9-10	0-1		0-2		0-3	0-4			0-1	
2	0-9	0-4	0-29		0-8										
1															
Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (n)	162	162	144	142	161	161	58	58	58	58	58	58	58	58	58

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Table 25

Scaled Scores: ages from 40 to 60 and years of education from 12+

Scaled score	WMS-III Logical Memory I	WMS-III Logical Memory II	WMS-III Visual Reproduction I	WMS-III Visual Reproduction II	CERAD Immediate Memory	CERAD Delayed Memory	RAVLT Trial 1	RAVLT Trial 2	RAVLT Trial 3	RAVLT Trial 4	RAVLT Trial 5	RAVLT List B	RAVLT 3 minute Recall	RAVLT 20 minute Recall	RAVLT Recognition
19															
18	61–75	37–75	102–104	84–104	29–30		11–15	13–15	15	15				15	
17	53–60	36	96–101	79–83	27–28		8–10	12	13–14	14		9–15		14	
16	52		95	76–78	26							8			
15	49–51	34–35	92–94	73–75	25	10					15		14–15		
14	47–48	31–33	90–91	68–72		9	7	11	12	13	14		13	13	
13	44–46	29–30	87–89	65–67	23–24	8		10			13	7	12	12	
12	41–43	26–28	82–86	59–64	22		6	9	11			5–6	11	11	15
11	38–40	24–25	77–81	52–58	21	7				12	12			10	14
10	35–37	22–23	75–76	48–51	20	6	5	8	10	11		4	9–10	9	
9	33–34	20–21	71–74	41–47	18–19				9	10	10–11	3	8		
8	29–32	17–19	67–70	34–40	17	5	4	7						8	
7	26–28	15–16	65–66	29–33	16				8	9	9		7	7	13
6	24–25	11–14	61–64	24–28	15	4		5–6		8	8	2		6	10–12
5	21–23	10	55–60	13–23	14		3	0–4	6–7	7		0–1			
4	19–20	8–9	54	0–12		3	0–2		5		6–7		5–6	5	9
3	18	0–7	41–53		13	1–2			0–4		0–5		0–4	0–4	0–8
2	0–17		0–40		0–12	0									
1															
Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (n)	125	125	100	95	124	124	44	44	44	44	44	44	44	44	44

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Table 26

Scaled Scores: ages 61+ and years of education from 12+

Scaled score	WMS-III Logical Memory I	WMS-III Logical Memory II	WMS-III Visual Reproduction I	WMS-III Visual Reproduction II	CERAD Immediate Memory	CERAD Delayed Memory	RAVLT Trial 1	RAVLT Trial 2	RAVLT Trial 3	RAVLT Trial 4	RAVLT Trial 5	RAVLT List B	RAVLT 3 minute Recall	RAVLT 20 minute Recall	RAVLT Recognition
19															
18	56-75	37-75	101-105	80-105	28-30										
17	51-55	34-36	96-100	79	27						15	7-15		13-15	
16	50	33	93-95	76-78	26	10	8-15	11-15	13-15	14-15	14	6	13-15	12	
15	47-49	31-32	90-92	72-75	24-25	9	6-7	10	12	13		5	12		
14	45-46	29-30	86-89	66-71				9	11	12	13				
13	42-44	27-28	83-85	60-65	22-23	8			10	11				10-11	
12	38-41	24-26	77-82	53-59	21		5	8	9	10	11-12	4	10		15
11	37	22-23	73-76	46-52	20	7		7		9			9	8-9	14
10	33-36	20-21	68-72	37-45	19	6	4	6	8		10		7-8	7	13
9	30-32	18-19	64-67	30-36	18			5		8	9				
8	28-29	16-17	56-63	26-29	17	5	3		7			3	5-6	6	12
7	26-27	14-15	51-55	21-25	15-16	4				6-7			4		
6	24-25	12-13	45-50	15-20	14		1-2		6	5	7-8	2			11
5	22-23	11	40-44	12-14	13	3	0	4	0-5	0-4	5-6	1	2-3	4-5	4-10
4	20-21		36-39	11	12			0-3			0-4	0	0-1	0-3	0-3
3	15-18	6-10	33-35	8-10	5-11	2									
2	0-14	0-5	0-32	0-7	0-4	0-1									
1															
Type of score for each test	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count	Correct Count
Sample size (n)	212	212	203	198	209	209	32	32	32	32	32	32	32	32	32